Doty

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION V

DATE: 04 JUN 1987

SUBJECT: Potential Air Toxics Impacts Due To Air Stripping At The Old Mill Site - Rock Creek, Ohio

FROM: Steve Rothblatt, Chief
Air and Radiation Branch (5AR-26)

TO: Mary Gade, Acting Chief
Emergency and Remedial Response Branch (5HR-11)

Toxic compounds have been monitored in the groundwater below a waste dump site near Rock Creek, Ohio (this site is referred to as the Old Mill site). This site has been designated as a Superfund hazardous waste remedial action site. An analysis of this site has identified an air stripping system as a possible component of the overall decontamination process. Such air stripping leads to the air release of Volatile Organic Compound (VOCs) and other volatile gases. Several of the VOCs found in the groundwater of the Old Mill site have been identified as possible carcinogens. In addition, the U.S. Environmental Protection Agency (USEPA) is becoming increasingly concerned about the emissions of radon from air strippers. Radon is found at varying concentrations in groundwater depending on local, natural source strengths. The following report deals with a risk assessment for emissions from air stripping at the Old Mill site.

Review of the 30 percent completion report for possible radon impacts leads to the conclusion that minimal, non-significant impacts should occur. This will definitely be the case at the low water throughput (15 gallons per minute) projected as maximum load for the air stripper.

The model used in the analysis of VOC impacts was the Industrial Source Complex (ISC) model as included in the Graphical Exposure Modelling System (GEMS) maintained by USEPA's Office of Toxic Substances. Two model runs were performed, one run to assess peak concentrations near the air stripper and a second run to assess the aggregate exposure to persons within 50 kilometers. The inputs to these runs were taken from the 30 percent completion report.

The analysis performed was based on the worst-case (highest) monitored groundwater concentrations given in the 30 percent completion report. The report was not thorough in its documentation of groundwater pollutant concentrations. A number of tables with pollutant concentrations were given. These tables did not give specific references to concentration units and did not identify specifically the groundwater pollutant concentrations found at test sites. The water pollutant concentrations used in this analysis were taken from "sheet 3 of 4" in Section 7 of the report. This

data sheet references concentrations for "contaminated ground water" and "air stripper feed" (two distinctly different sets of pollutant concentrations). The report implies that water pollutatant concentrations at the inlet to the air stripper will be less than the groundwater concentrations. To be conservative and thorough, both sets of concentrations were used. The concentration units were assumed to be micrograms per liter (ug/L). It is assumed that the concentrations labeled as "contaminated ground water" in Section 7 of the report are the maximum concentrations actually monitored at the Old Mill site.

The 30 percent completion report does document the proposed dimensions of the air stripper in Section 2 of the report. In the report, it is stated that the stripper will be designed for a flow rate of 15 gallons water per minute. This flow rate was used in the risk assessment. Other stack dimensions given in Section 2 of the report were also used in the risk assessment analysis.

The modelled emission rates were based on the water pollutant concentrations times the amount of water to be processed per unit time. A plume height of 9.3 meters was used, representing a stack height of 7.3 meters and an assumed momentum plume size of 2 meters (buoyant plume rise is assumed to be zero).

The dispersion assessment used STAR meteorological summary data from Cleveland Hopkins Airport. Data on the distribution of population around the stripper site were supplied by GEMS, based on Census Bureau data.

The analysis assumed the stripper would be 100 percent efficient in volatilizing VOC from the water. This conservatively leads to the highest possible calculated emission rates. The impacts of additional emission control devices were not factored into the analysis. If vent/stack emissions were passed through a carbon adsorber, the VOC emissions would be substantially reduced. A carbon adsorber is commonly assumed to reduce emissions by up to 90 percent.

It should be noted that not all of the VOC listed in the 30 percent completion report were modelled in this analysis. The Region V Air & Radiation Division has estimates of dose-response relationship only for the compounds listed on Table 1. This list contains the following compounds also found at the Old Mill Site: trichloroethylene: tetrachloroethylene: 1,1,1trichloroethane: ethylbenzene: phenol: vinyl chloride: 1,1-dichloreothylene: chloroform: and methylene chloride. Since the report shows no concentration drop for phenol between the contaminated water and the stripped outlet water, it is assumed that no phenol will be emitted by the air stripper.

Amongest the toxic VOC that could be emitted at the site, quantitative estimates of carciogenicity are available only for: trichloroethylene: vinyl chloride: 1,1-dichloroethylene: chloroform: and methylene chloride. The unit risk factors used in the analysis are attached as Table 2. These factors were combined with peak air concentrations to obtain peak risk factors. The cumulative population exposure within 50 kilometers of the site was combined with the unit risk factors to calculate cumulative risks of cancer.

Results

Under the conditions modelled, a hypothetical water pollutant concentration of 1 milligram per liter translates to an emission rate of 9×10^{-4} grams per second (0.2 pounds per day). Such an emission rate would cause a peak concentration of 2.2×10^{-2} micrograms per cubic meter at 120 meters from the air stripper and an aggregate population exposure of 6.45 person - micrograms per cubic meter within 50 kilometers of the air stripper. These results were effectively adjusted for each pollutant taking into account the actual water based concentrations.

Table 3 lists the important input data and results for the modelled toxicants at the contaminated groundwater concentrations given in the 30 percent completion report. The cited unit risk factors represent the risk of cancer per lifetime exposure to a reference concentration of 1 microgram per cubic meter. The unit risk factors were taken from health assessment documents and other data available within USEPA.

The results in Table 3 show that the total (for the modelled pollutants with risk factors) peak risk (at 120 meters from the air stripper) of cancer during a lifetime is 1.94×10^{-7} and the total cumulative risk to all population within 50 kilometers is 8.06×10^{-7} cases per year or one cancer case per 1,241,000 years.

Table 4 lists the important input data and results for the modelled toxicants at the water base concentrations at the air stripper inlet as listed in the 30 percent completion report. The results show that the total peak risk of cancer during a lifetime at 120 meters from the air stripper is 2.54×10^{-8} and the total cumulative risk to all population within 50 kilometers is 1.05×10^{-7} cases per year or one cancer case per 9,524,000 years.

It is important to recognize various caveats which must be said about this analysis. The most important caveat is that the modelled emissions rates reflect current, worst case water pollutant concentrations. As the water purification process proceeds, water pollutant concentrations will fluctuate at or below the worst case concentrations and may decrease as water from the outer limits of the polluted ground plume is drawn into the air stripper intakes. As the cleanup proceeds, one may expect the air toxicant based health risks to decrease. A second caveat is that the peak risks reflect lifetime (about 70 years) exposure. If the air stripper is not operated for a full lifetime, the peak risk should be lower. Third, it's important to recognize a number of uncertainties in the analysis. The unit risk factors are based on several assumptions including linearity of dose response relationships and the transferability of animal (primarily rodent) experimental data to humans. The unit risk factors are chosen to give a high confidence that responses to given doses are not underestimated. The analysis also contains uncertainty in the modelled dispersion estimates, the groundwater

concentration estimates, and numerous lesser uncertainties. Therefore, the results of this analysis should be considered simply as estimates of the peak risks and cumulative risks which could be caused by the air stripper under worst case conditions.

Attachments

cc: David Kee

bcc: w/attachments
Mary Tyson (5HR-11)
Gary Gulezian
Edward Doty
John Summerhays

Table 1
Air Toxicants

1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE
1,1-DICHLOROETHYLENE
1,2-DICHLOROBENZENE
1,2-DICHLOROETHANE
1,3-BUTADIENE
2,4,5-TRICHLOROPHENOL
2,4-DB
4,4-ISOPROPYLIDENE DIPHENOL
4,4-METHYLENE DIANILINE
ACRYLAMIDE
ACRYLIC ACID
ACRYLONITRILE
ALLYL CHLORIDE
ALUMINUM PHOSPHATE
ARSENIC
ASBESTOS
BARIUM
BARIUM CYANITE
BENZENE
BENZO(A)PYRENE
BENZYL CHLORIDE
BERYL ORE
BERYLLIUM
BERYLLIUM SULFATE
CACODYLIC ACID
CADMIUM
CALCIUM CYANIDE
CARBARYL
CARBON DISULFIDE
CARBON TETRACHLORIDE
CHLORINE CYANIDE
CHLOROBENZENE
CHLOROFORM
CHROMIUM (VI)
COKE OVEN EMISSIONS
COPPER CYANIDE
CRESOLS
CYANIDE
CYANOGEN
DIBENZFURANS
DICHLORODIFLUOROMETHANE
DIETHANOLAMINE
DIMETHOATE
DIMETHYLNITROSAMINE
DINOSEB
DIOCTYL PHTHALATE
DIOXIN
EPICHLORDHYDRIN
ETHYL ACRYLATE
ETHYLBENZENE
ETHYLENE
ETHYLENE DIBROMIDE
ETHYLENE DICHLORIDE
ETHYLENE OXIDE
FLUORIDE
FLUORINE
FORMALDEHYDE
FORMIC ACID
HEXACHLOROBENZENE
HYDROGEN CYANIDE
HYDROGEN SULFIDE
LINURON
MALATHION
MCPA
MECURY FULMINATE
MELAMINE
MERCURY (INORGANIC)
METHYL CHLORIDE
METHYL ETHYL KETONE
METHYL ETHYL KETONE PEROXIDE
METHYLENE CHLORIDE
NICKEL
NICKEL CYANIDE
NICKEL SUBSULFIDE
NITRIC OXIDE
NITROBENZENE
NITROSOMORPHOLINE
PCB'S
PENTACHLORONITROBENZENE
PENTACHLOROPHENOL
PERCHLOROETHYLENE
PHENOL
PHENYL MERCURIC ACETATE
PHOSPHINE
PIC (BaP)
POTASSIUM CYANIDE
POTASSIUM SILVER CYANIDE
PROPYLENE DICHLORIDE
PROPYLENE OXIDE
PYRIDINE
SELENIOUS ACID
SELENOUREA
SILVER CYANIDE
SODIUM CYANIDE
STRYCHNINE
STYRENE
TEREPHTHALIC ACID
TETRACHLOROETHYLENE
TETRACHLOROPHENOL
TETRAETHYL LEAD
THALLIC OXIDE
THALLIUM ACETATE
THALLIUM CARBONATE
THALLIUM CHLORIDE
THALLIUM NITRATE
THALLIUM SELENATE
THALLIUM SULFATE
TITANIUM DIOXIDE
TOLUENE
TRICHLOROETHYLENE
TRICHLOROFLUOROMETHANE
VINYL CHLORIDE
ZINC CYANIDE

Table 2.

Unit Risk Factors For The Modelled Pollutants

Pollutant	Unit Risk Factor $[(\text{person} - \mu g/m^3)^{-1}]$
Trichloroethylene	1.30×10^{-6}
Vinyl Chloride	4.10×10^{-6}
1,1-Dichloroethylene	5.00×10^{-5}
Chloroform	2.30×10^{-5}
Methylene Chloride	4.1×10^{-6}

Table 3

Cancer Risks For Pollutants At Contaminated Groundwater Concentrations

	WATER CONC. (UG/L)	EMISSIONS (#/DAY)	UNIT RISK	PEAK RISK	CUMULATIVE RISK (CASES/YR)
TRICHLOROETHYLENE	6100.0	1.1	1.30-005	1.76-007	7.31-007
TETRACHLOROETHYLENE	300.0	.1	.00	.00	.00
1,1,1-TRICHLOROETHAN	150.0	.0	.00	.00	.00
ETHYLBENZENE	1200.0	.2	.00	.00	.00
VINYL CHLORIDE	10.0	.0	4.10-006	9.10-010	3.78-009
1,1-DICHLOROETHYLENE	10.0	.0	5.00-005	1.11-008	4.61-008
CHLOROFORM	10.0	.0	2.30-005	5.11-009	2.12-008
METHYLENE CHLORIDE	10.0	.0	4.10-006	9.10-010	3.78-009
TOTAL RISKS	7790.0	1.4		1.9408-007	8.0583-007

Table 4
Cancer Risks For Pollutants At Air Stripper Inlet Water Concentrations

	WATER CONC. (UG/L)	EMISSIONS (#/DAY)	UNIT RISK	PEAK RISK	CUMULATIVE RISK (CASES/YR)
TRICHLORDETHYLENE	799.0	.1	1.30-005	2.31-008	9.58-008
TETRACHLORDETHYLENE	39.0	.0	.00	.00	.00
1,1,1-TRICHLORDETHAN	20.0	.0	.00	.00	.00
ETHYLBENZENE	160.0	.0	.00	.00	.00
VINYL CHLORIDE	1.2	.0	4.10-006	1.09-010	4.54-010
1,1-DICHLORDETHYLENE	1.3	.0	8.00-005	1.44-009	5.93-009
CHLORDFORM	1.3	.0	2.30-005	6.64-010	2.76-009
METHYLENE CHLORIDE	1.3	.0	4.10-006	1.18-010	4.91-010
TOTAL RISKS	1023.1	.2		2.5394-008	1.0545-007

5/13/87

After reviewing the 30% Completion Report for the Old Mill Site, Rock Creek, Ohio, the radiation program staff did not find any potential radiation problems associated with the remedial design.

Ed-

We did not see any problems with this site.

Debbie